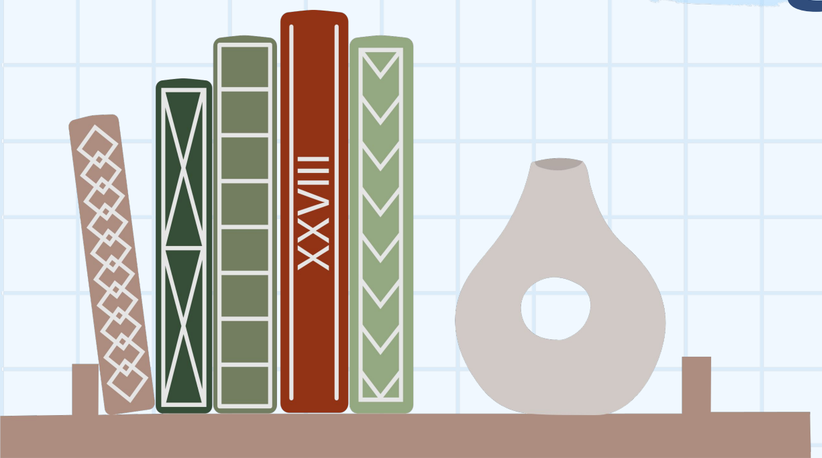
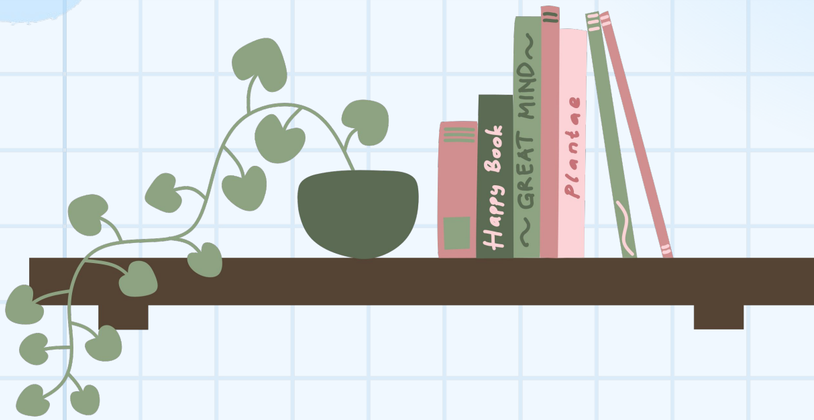
BS./BSC.

Applied AI and Data Science

Algorithmic Thinking & its Applications





Structure vs. Flow

Program StructureProgram Flow

- Order code is **presented**
  - Order statements are listed
  - Inside/outside of function
  - Will see other ways…
- Defines possibilities over **multiple executions**

- Order code is **executed**
  - Not the same as structure
  - Some statements duplicated
  - Some statements skipped
- Defines what happens in a **single execution**

Have already seen this difference with functions

Structure vs. Flow: Example

Program Structure Program Flow

```
def foo():
    print('Hello')

# Script
Code foo()
foo()
foo()
```

```
> python foo.py
'Hello'
'Hello'
'Hello'
```

Statement listed once

Statement executed 3x

Bugs occur when flow does not **match** expectations

Conditionals: If-Statements

Format

```
if expression :
    statement
    ...
    statement
```

Indent

Example

```
# Put x in z if it is
positive if x > 0:
    z =
    x
```

Execution:

If *expression* is **True**, execute all statements **indented** underneath

Python Tutor Example

Conditionals: If-Else-Statements

Format	Example

if *expression* :
  statement
  ...
else
: *statement*
  ...
	# Put max of x, y
	in z if x > y:
	  z = x
	else
	: z = y

Execution:

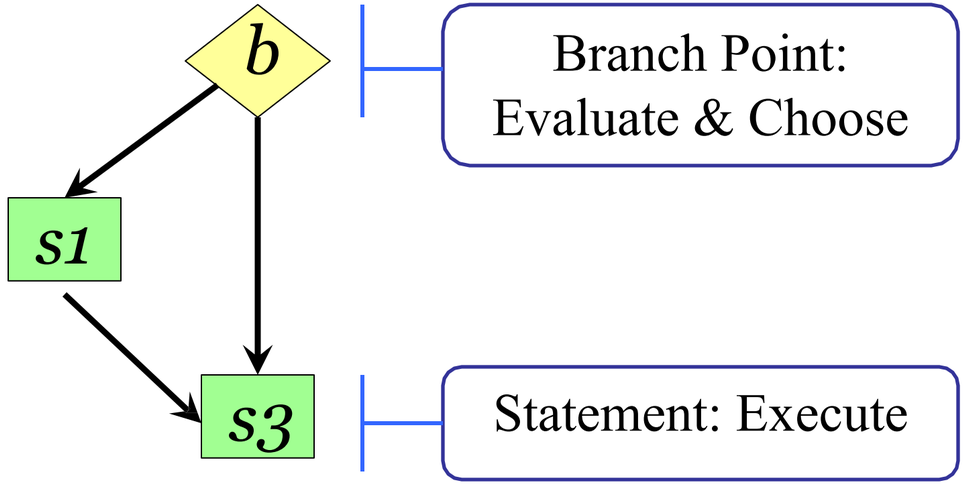
If *expression* is **True**, execute all statements indented under if.

If *expression* is **False**, execute all statements indented under else.

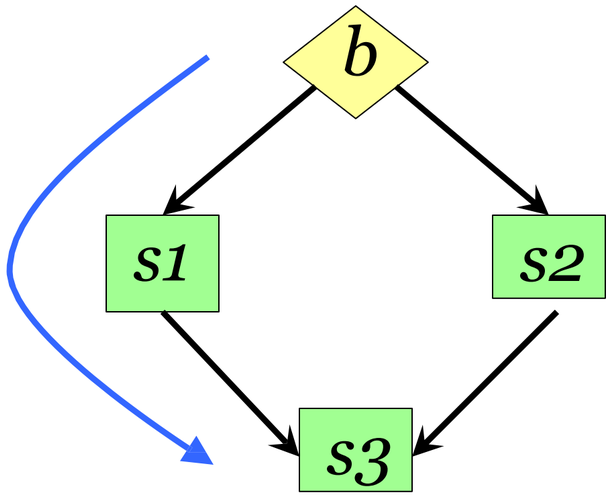
Python Tutor Example

Conditionals: "Control Flow" Statements

```
if b
:
    s1 # statement
s3
```




```
if b
:   s1
else
:   s2
s3
```



Flow

Program only takes one path each execution

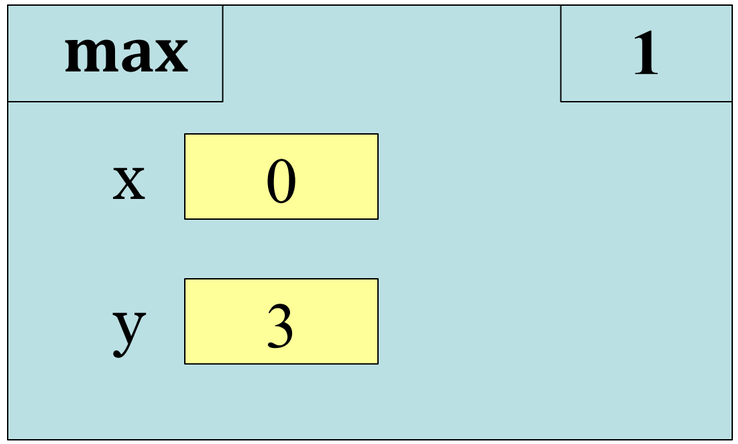
Program Flow and Call Frames

```
def max(x,y):
    """Returns: max of x,
    y""" # simple
    implementation
1   if x > y:
2       return x
3   return y
```

Frame sequence depends on flow

max(0,3)

:



Program Flow and Call Frames

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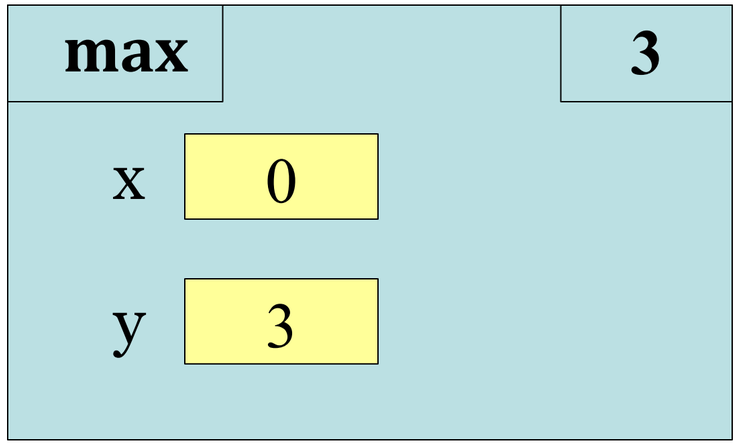

Skips line 2

Frame sequence depends on flow

Program Flow and Call Frames

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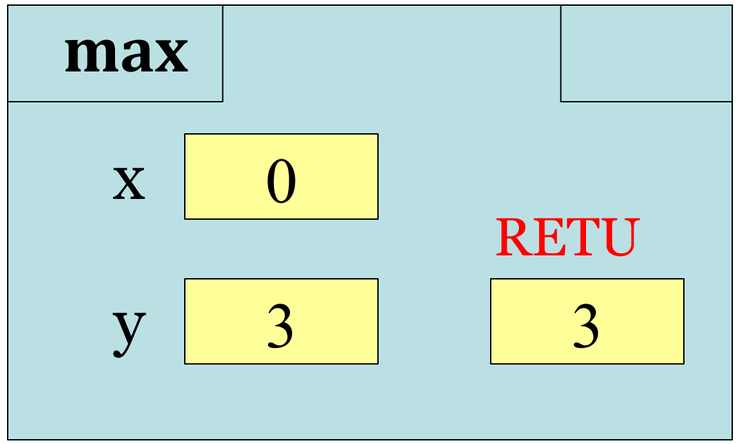


Skips line 2

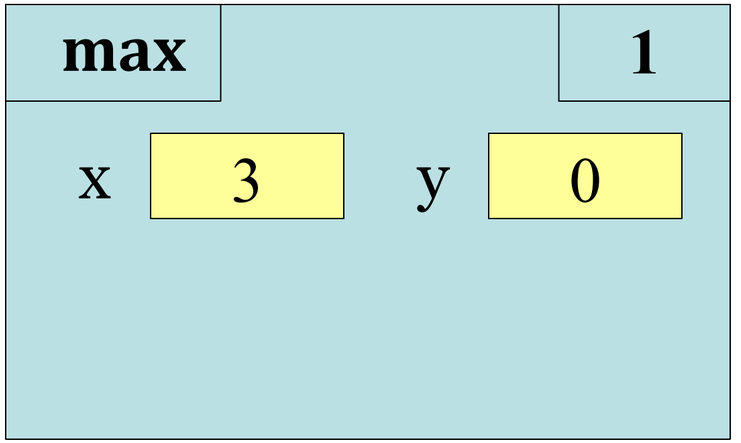
Frame sequence depends on flow

Program Flow vs. Local Variables

```
    def max(x,y):
        """Returns: max of x,
        y""" # swap x, y
        # put the larger in y
1       if x > y:
2           temp = x
3           x = y
4           y = temp

5       return y
```

- max(3,0):



Swaps max into var y

Program Flow vs. Local Variables

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def max(x,y):
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```

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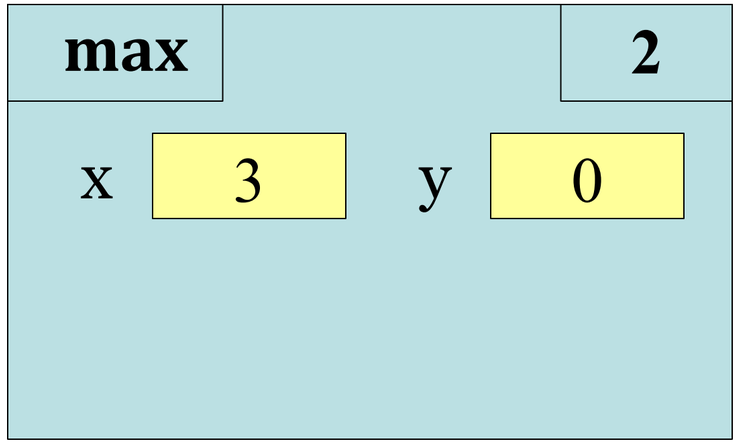

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Program Flow vs. Local Variables

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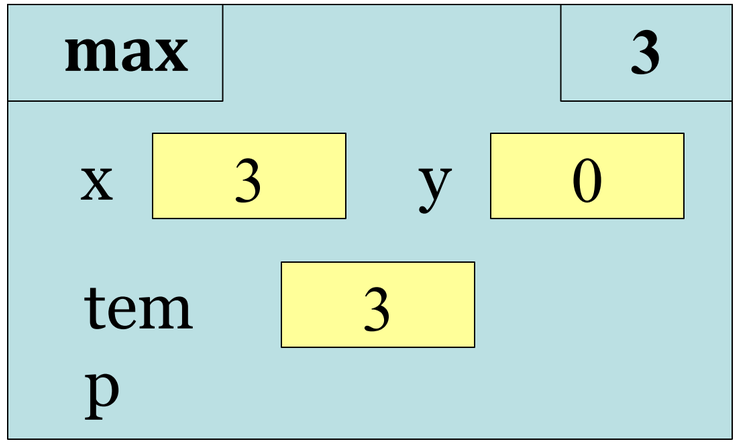

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Program Flow vs. Local Variables

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3       x = y
4       y = temp

5   return y
```

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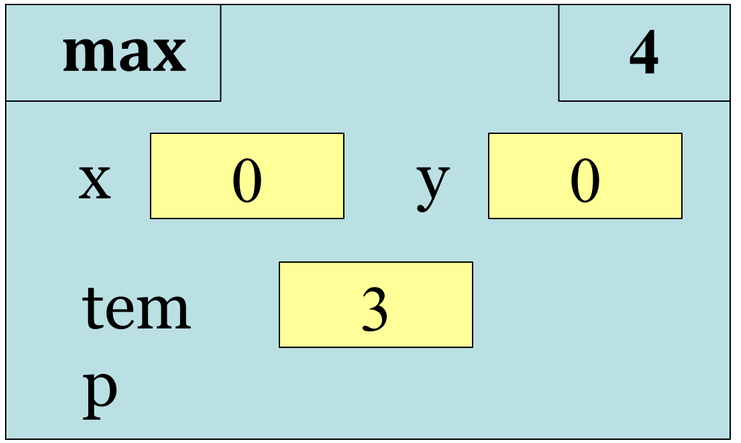

Swaps max into var y

Program Flow vs. Local Variables

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4       y = temp

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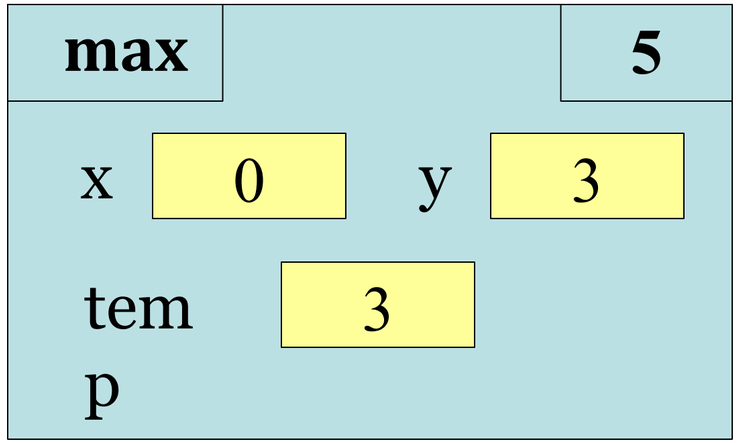

Swaps max into var y

Program Flow vs. Local Variables

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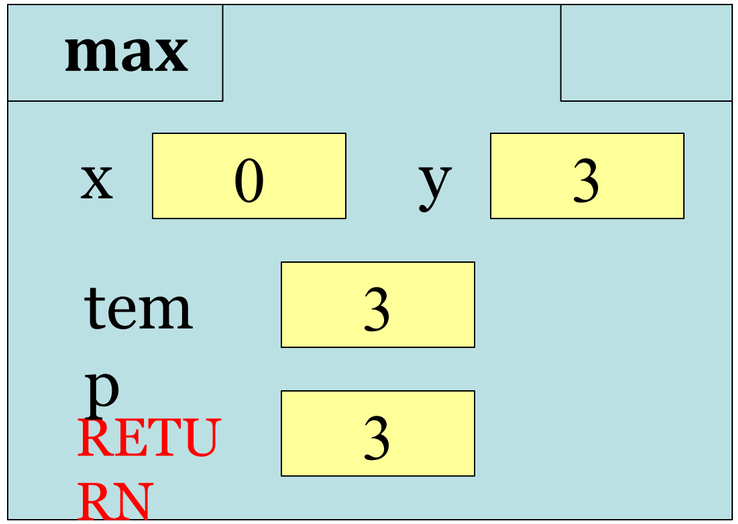
- max(3,0):



Swaps max into var y

Program Flow vs. Local Variables

```
def max(x,y):
    """Returns: max of x, y""" # swap x, y

    # put the larger in y
1   if x > y:
2       temp = x
3       x = y
4       y = temp


5   return temp
```

- Value of max(3,0)?

A: 3
B: 0
C: **Error!**
D: I do not know

Conditionals: If-Elif-Else-Statements

Format

```
if expression :
    statement
    ...
elif expression :
    statement
    ...
...
else
:   statement
    ...
```

Example

```
# Put max of x, y, z in w if
x > y and x > z:
    w = x
elif y > z:
    w = y
else
:   w = z
```

Conditionals: If-Elif-Else-Statements

Format

```
if expression :
    statement
    ...
elif expression :
    statement
    ...
...
else
:   statement
    ...
```

Notes on Use

- No limit on number of elif
  - Can have as many as want
  - Must be between if, else
- The else is always optional
  - if-elif by itself is fine
- Booleans checked in order
  - Once it finds first True, skips over all others
  - else means **all** are false

Python Tutor Example

Conditional Expressions

Format Example

e1 if bexp else e2

- e1 and e2 are *any* expression
- bexp is a boolean expression
- This is an expression!
  - **Evaluates** to e1 if bexp True
  - **Evaluates** to e2 if bexp False

```
# Put max of x, y in z z
= x if x > y else y
```

expression, not statement

Thank you